



A new skink (Scincidae: *Carlia*) from the rainforest uplands of Cape Melville, north-east Australia

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Abstract

Carlia skinks are widespread in New Guinea, Wallacea, and northern and eastern Australia. Most Australian species occur in dry woodlands and savannas or marginal rainforest habitats associated with these. There are two rainforest species, parapatrically distributed in coastal mid-eastern Queensland (*C. rhomboidalis*) and the Wet Tropics of north-eastern Queensland (*C. rubrigularis*). These two sister species share a diagnostic morphological trait in having the interparietal scale fused to the frontoparietal. Here I describe a third species in this group, *Carlia wundalthini* **sp. nov.**, from rainforest uplands of the Melville Range, a rainforest isolate 170 km north of the Wet Tropics. This species is diagnosable on male breeding colouration, morphometrics and scalation. The description of *C. wundalthini* **sp. nov.** brings the number of vertebrate species known to be endemic to the rainforest and boulder-fields of Cape Melville to seven. *Carlia wundalthini* **sp. nov.** is distinct among these endemics in being the only one that does not appear to be directly associated with rock, being found in rainforest leaf-litter.

Key words: *Carlia rubrigularis*, *Carlia rhomboidalis*, Cape York, rainforest, boulder-field, lithoreugia, Queensland

Introduction

Carlia Gray, 1845 is a skink genus consisting of 42 species found in Australia, New Guinea and the Wallacea region of Southeast Asia (Donnellan *et al.* 2009; Zug 2010; Hoskin & Couper 2012). Only one species, *C. storri* Ingram & Covacevich, 1989, is shared between Australia and New Guinea. The majority of the 23 species found in Australia occur in north-eastern and coastal Queensland (Hoskin & Couper 2012). Most *Carlia* species inhabit open forests. While some of these also occur in rocky or gallery rainforests and vine thickets (e.g., *C. rimula* Ingram & Covacevich, 1980 and *C. decora* Hoskin & Couper, 2012), only *C. rhomboidalis* (Peters, 1869) and *C. rubrigularis* Ingram & Covacevich, 1989 could be considered ‘true’ rainforest species. These two species inhabit rainforest and associated wet sclerophyll forest in parapatric distributions along the east coast of Queensland. *Carlia rhomboidalis* occurs from about Mackay to Townsville and *C. rubrigularis* is restricted to the Wet Tropics region from Townsville to Cooktown. *Carlia rubrigularis* is abundant in the Wet Tropics, with the most northerly records being about 25 km south of Cooktown. The collection locality of a single specimen (QM J22945) from ‘Marina Plains’, about 160 km north-west of Cooktown, has been deemed erroneous due to the lack of any potentially suitable habitat in this region (Ingram & Covacevich 1989).

Carlia rubrigularis and *C. rhomboidalis* can be distinguished from all other *Carlia* in having the interparietal scale fused with the frontoparietal (Ingram & Covacevich 1989; Hoskin & Couper 2012). *Carlia rubrigularis* was split from *C. rhomboidalis* in 1989 on the basis of colouration, particularly of breeding males (Ingram & Covacevich 1989). In *C. rhomboidalis* the labials and underside of the head are blue and the throat is red (Fig. 1A), whereas in *C. rubrigularis* the entire lower surfaces of the head (termed here the ‘chin’) and throat are red (Fig. 1B). This colour difference in breeding males was deemed probably sufficient to confer breeding isolation should the species come into contact (Ingram & Covacevich 1989). Indeed, lab-tests of female choice have detected prezygotic isolation between these two species (Dolman 2008). Ingram & Covacevich (1989) concluded that the

two species were morphologically indistinguishable other than for chin colour; however, Dolman (2008) also found subtle differences in relative limb length and head width. Phylogeographic analysis of *C. rubrigularis* populations has revealed two deeply divergent genetic lineages, representing the northern and southern Wet Tropics (Schneider *et al.* 1999; Dolman & Moritz 2006). These two lineages are morphologically indistinguishable, including for chin and throat colour, despite detailed examinations (Schneider *et al.* 1999; Dolman 2008). Analyses of the secondary contact between the two lineages in the central Wet Tropics have concluded that there is substantial postzygotic isolation between the lineages but no evidence for prezygotic isolation (Phillips *et al.* 2004; Dolman & Moritz 2006; Dolman 2008). The taxonomy of the two apparently phenotypically indistinguishable lineages of *C. rubrigularis* remains unresolved.

Over several trips in 2013 I surveyed the fauna of the Melville Range on Cape Melville, a rainforest isolate approximately 170 km north of the Wet Tropics. These surveys revealed a number of new species, including one frog and four reptile species (see Discussion). One of these new species belongs to the *C. rhomboidalis* species-group and it is described herein. As for *C. rhomboidalis* and *C. rubrigularis*, the new species has the interparietal fused with the frontoparietal and occurs in rainforest. The new species is diagnosable based on male breeding colouration, morphometrics and scalation. It was discovered during surveys of the rainforest uplands of the Melville Range in March 2013 and males in breeding colour were collected in December 2013.

Methods

Specimens examined, including all type material, are held in the Queensland Museum (QM J numbers). All measurements were taken using Mitutoyo electronic calipers and rounded to the nearest 0.1 mm. The following measurements were taken: snout to vent length (SVL); length of original tail (TL), from posterior margin of anal scale to tip of tail (original versus regenerated tail determined by eye); axilla to groin length (AG) (i.e., inter-limb distance); body width (BW), measured at widest point (typically midbody); length of forelimb (L1) and hindlimb (L2), in both cases measured from insertion to tip of longest digit (claw included), with limb stretched straight perpendicular to body; lower hindlimb length (HLL) (i.e., tibiofibula length), measured from knee to heel with hindlimb compressed against body; forearm length (FL) (i.e., radioulna length), measured from elbow to 'heel' of the palm with forelimb compressed; head width (HW), measured just anterior to the tympana at widest point of the head; head length (HL), from anterior margin of ear to tip of snout; neck length (NL), from anterior insertion of forelimb to posterior margin of ear; eye to ear (EE), anterior margin of ear to posterior margin of eye; eye to naris (EN), anterior margin of eye to posterior margin of naris. Specimen weight (WT) was taken as a measure of how gracile or robust (i.e., mass/SVL) each species is. This was performed using an electronic balance and only specimens that had the majority of their tail were weighed. All measurements stated for *C. rubrigularis* (N = 24) and *C. rhomboidalis* (N = 21) were taken on the specimens listed in the Appendix.

The following scale traits were counted: midbody scale rows; paravertebral scales, number of scales from anterior-most nuchal to a point in line with posterior margin of hindlimb; supralabials, enlarged series along top of jaw extending back just beyond angle of jaw; infralabials, enlarged series along bottom of jaw extending back to scale with posterior margin contacting last supralabial; supraciliaries; supraoculars; loreals; nuchals, number of scales bordering the posterior margin of the parietal scales; subdigital lamellae, counts of obviously enlarged transverse series beneath 4th toe and 3rd finger and including claw sheath. The following scale traits were also scored: keels on the dorsal scales of the midbody; shape and contacts of the upper preocular scale (variation in *Carlia* spp. ranges from a thin sliver well separated from the second loreal scale through to upper preocular being large and contacting second loreal scale, Hoskin & Couper 2012); size of the palpebral disc relative to size of ear opening; shape and orientation of the ear opening; number of ear lobules and their shape; degree of separation between the nasals; degree of separation between the prefrontals. Scales were generally counted/scored on the right side of the specimen.

The sex of adult specimens was determined by breeding colours (less pronounced or absent in females) and white mid-lateral markings (absent or less pronounced in males). Colour pattern in life was assessed during two trips to the uplands of Cape Melville: March 2013 and December 2013. Male *C. wundalthini* **sp. nov.** were in breeding colour in December but not in March. Male *C. rubrigularis* were also observed in full breeding colour during fieldwork in Lamb Range and the Carbine Tableland immediately before and after the December trip to

Cape Melville. These observations fit the recorded breeding seasons for tropical Australian *Carlia* species. Assessment of breeding condition of females and males suggests a peak breeding season of September–February in *C. rubrigularis* (Dolman 2008) and October–February in some tropical *Carlia* of the Northern Territory (James & Shine 1985).

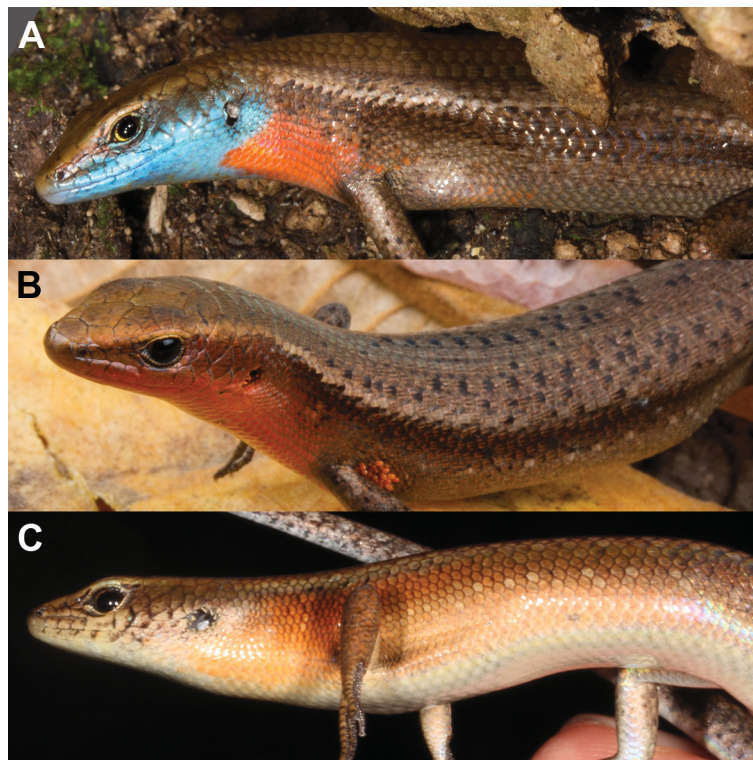


FIGURE 1. Breeding males of: (A) *C. rhomboidalis* (Magnetic Island), (B) *C. rubrigularis* (Kirrama Range) and (C) *C. wundalthini* sp. nov. (Melville Range). Photos A and B courtesy of Stephen Zozaya.

Systematics

Although Hedges & Conn (2012) proposed splitting Scincidae into seven families, I follow the more detailed genetic analysis of Pyron *et al.* (2013) in not splitting Scincidae. The new species of scincid lizard described here is assigned to *Carlia* by the following character states: adult SVL to 49 mm; limbs well-developed; forelimbs tetradactyle; hindlimbs pentadactyle; frontoparietal scales fused; parietals in contact; lower eyelid with a transparent, movable palpebral disc; supranasal scales absent; 4 supraoculars; breeding males with bright colours, females without bright colours but with white mid-lateral markings (Ingram & Covacevich 1989; Cogger 2000; Dolman & Hugall 2008).

Carlia wundalthini sp. nov.

Cape Melville Rainbow Skink
(Figs 1C, 2, 3, 4A, 5, 6A, 6B)

Holotype. QM J93342 (field number N86248), adult male, Melville Range (14°16'33" S, 144°29'32" E, elevation 460 m a.s.l.), Cape Melville, north-east Queensland, C. J. Hoskin & H. B. Hines, 13 December 2013.

Paratypes. QM J93343 (field number N86249), adult male; QM J93344 (field number N86250), adult male; QM J93345 (field number N86252), adult male; QM J93346 (field number N86258), adult male; QM J93347 (field number N86261), adult female; collection details as for holotype. QM J92563, adult, probable female; QM J92564, subadult; QM J92565, subadult; QM J92566, subadult; QM J92575, adult, probable female; QM J92576, subadult; Melville Range (14°16'38" S, 144°29'28" E, elevation 500 m a.s.l.), Cape Melville, north-east Queensland, C. J. Hoskin, 20 March 2013.



FIGURE 2. *Carlia wundalthini* sp. nov. in life (holotype, QM J93342, male).

Diagnosis. Distinguished from congeners by combination of interparietal fused with frontoparietal, smooth dorsal scales, small–medium size (max SVL to about 49 mm), male breeding colour consisting of orange flush down side of neck and flank and pale chin and throat (Figs 1C, 2, 3), round to horizontally elongate ear opening with sharp triangular lobule at front of ear and similar sharp lobules at least across the top of ear and often around entire margin (Figs 1C, 2, 4A).

Etymology. Wundalthini was the name of Charlie Monaghan, a Traditional Owner who was born in the Cape Melville area and who passed on much of the knowledge and responsibility for that country to the current generation of its Traditional Owners. The species was named by the *bubu gudjin* of Cape Melville, the Traditional Owners who have the responsibility to speak for the land where the species lives.

Measurements and scale counts of holotype (Figs 4A, 5). SVL = 45.7 mm, TL (original) = 79.1 mm, AG = 21.1 mm, BW = 9.0 mm, L1 = 15.9 mm, FL = 6.8 mm, L2 = 21.1 mm, HLL = 7.2 mm, 4th toe length = 6.7 mm, NL = 8.2 mm, HL = 9.9 mm, HW = 7.6 mm, EE = 3.6 mm, EN = 2.3 mm, WT = 2.4 g, midbody scale rows = 32, paravertebrals = 45, subdigital lamellae 4th toe = 31, subdigital lamellae 3rd finger = 19, supraoculars = 4, supralabials = 7, infralabials = 6, supraciliaries = 7, loreals = 2, nuchals = 4.

Description of type series. Data presented as range followed by mean in brackets. **Adult** (*N* = 8) **measurements** (mm, except WT): SVL = 36.7–49.0 (43.6), TL (original) = 54.7–79.1 (66.1), AG = 16.9–23.5 (19.4), BW = 8.0–11.0 (9.2), L1 = 11.7–16.9 (15.0), FL = 4.5–6.8 (5.6), L2 = 17.5–22.0 (20.1), HLL = 5.4–7.4 (6.7), 4th toe length = 5.1–6.8 (6.2), NL = 6.4–8.5 (7.4), HL = 8.2–10.5 (9.5), HW = 6.1–8.0 (7.2), EE = 3.0–4.3 (3.6), EN = 2.0–3.0 (2.3), WT = 1.4–2.8 g (2.2 g). **Adult proportions** (as % SVL): TL (original) = 140.8–182.4 (160.9), AG = 40.4–47.9 (44.5), BW = 19.6–22.4 (21.1), L1 = 31.2–38.1 (34.4), FL = 12.0–14.8 (12.9), L2 = 44.4–49.2 (46.2), HLL = 14.7–16.4 (15.4), 4th toe length = 13.0–15.4 (14.2), NL = 14.4–17.8 (17.0), HL = 21.0–22.9 (21.9), HW = 15.8–17.1 (16.6), EE = 7.6–9.1 (8.2), EN = 4.6–6.3 (5.3), WT = 3.8–6.0 (5.0). **Body** moderately robust. Head barely distinct from neck. Snout rounded in profile. Limbs moderate; four fingers; five toes. **Scalation** (*N* = 12, range given where there is variation): Dorsal scales smooth but generally indication of 2 or 3 weak striations or keels; posterior edge of scales smoothly curved. Rostral in broad contact with frontonasal. Nasals widely spaced. Prefrontals large and moderately to widely separated. Supraoculars 4; 1 and 2 in contact with frontal; 2, 3 and 4 in contact with frontoparietal. Frontoparietals fused, forming a single shield. Interparietal fused with frontoparietal. Enlarged nuchal scales 4; generally (*N* = 9) a second similar row of enlarged scales immediately behind nuchals. Loreals 2. Preoculars 2. Presubocular single. Supraciliaries 7. Upper preocular a well developed ‘blocky wedge’

that broadly contacts posterior edge of 2nd loreal scale (Fig. 4A). Lower eyelid movable, with clear window; palpebral disc moderate size (about same size as ear aperture), occupying more than half of lower eyelid (Fig. 4A). Ear opening round (N = 10) to horizontally elongate (N = 2), with a single sharp triangular lobule at front (or in one case two anterior lobules) and similar sharp triangular lobules around upper half of ear (in all cases), and similar sized, sharp triangular lobules along lower margin (i.e., around entire margin of ear) (N = 5) or smaller lobules on lower margin (N = 5) or no lobules on lower margin (N = 2). Supralabials 7, with the fifth broad and positioned below the eye. Infralabials 6. Three scales between the nasal scale and the presubocular. Midbody scale rows 30–33 (mean = 31.5). Paravertebral scale rows 44–46 (mean = 45.2). Subdigital lamellae under 3rd finger 19–21 (mean = 19.9). Subdigital lamellae under 4th toe 27–31 (mean = 29.2).

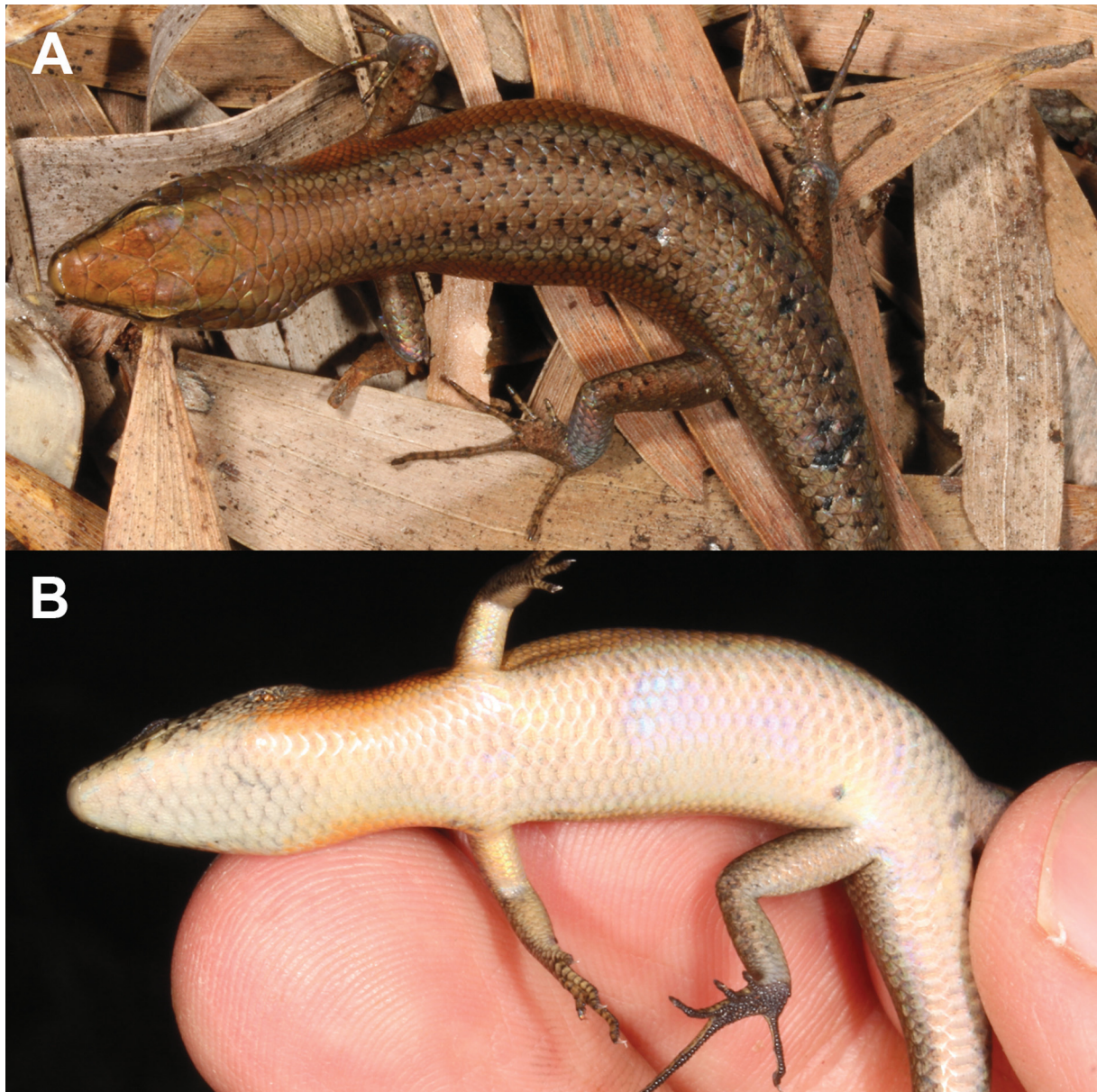


FIGURE 3. *Carlia wundalthini* sp. nov. dorsal (A) and ventral (B) surfaces of breeding male in life (holotype, QM J93342).

Colour pattern in preservative (Fig. 5). Dorsal surfaces brown with paired fine black flecks along dorsum in some individuals (e.g., QM J93342, QM J93345). Top of head copper brown, merging with brown on neck. All scales on dorsal and lateral surfaces finely edged with black. Original tail brown and more heavily flecked with black; white flecks noticeable in some individuals (e.g., QM J93342, QM J93346). Regenerated tail light brown. Copper green tinge to top of neck in some specimens (e.g., QM J93345, QM J93347). Lateral surfaces of males copper, with green tinge on sides of neck. Lateral surfaces of females dark brown with regular mid-lateral white

spots from neck to hindlimb. Slight indication of pale dorsolateral line in some females (e.g., QM J93347). Ventral surfaces of both sexes pale, with a cream or grey tinge. Underside of chin generally white; underside of throat generally cream with a bluish tinge; underside of chest and belly generally pale with a grey tinge; underside of hands and feet dark grey; undersides of digits black.

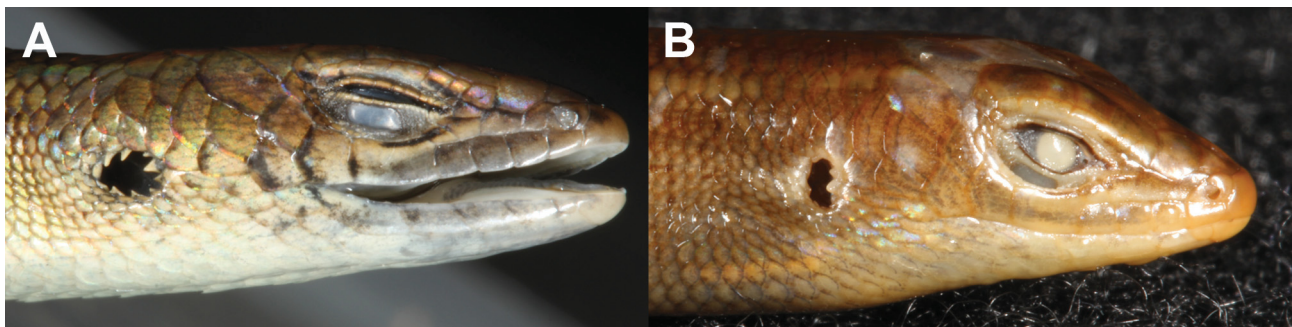


FIGURE 4. The holotypes of (A) *C. wundalthini* sp. nov. (QM J93342) and (B) *C. rubrigularis* (QM J29956), showing ear openings and other aspects of head scalation.



FIGURE 5. Holotype of *C. wundalthini* sp. nov. (QM J93342): (A) dorsolateral, (B) ventral.

Colour pattern in life (Figs 1C, 2, 3, 6A, 6B). Colour pattern in life was assessed from the type series and from observations of a large number of other individuals during fieldwork at Cape Melville in March and December 2013. Dorsal surfaces brown with scattered black and white flecks; rainbow sheen at certain angles; copper tinge to top of head (Fig. 3A). Labials through to ear region pale or yellowish, with dark edging to scales; flank colour and pattern differs between males, females and subadults (see below). Ventral surfaces pale (white or cream); underside of feet black. Breeding males have orange flush down sides of neck and flanks, most prominent on sides of neck and anterior flank and generally fading out and becoming more concentrated towards the upper flank posteriorly (Figs 2, 6A); orange on side of neck sometimes extends faintly onto edges of throat (Fig. 3B). Females have brown flanks, darker on the upper flank; some indication of a paler brown dorsolateral line from the

snout to the base of the tail, and a series of pale mid lateral spots from the side of the neck to the groin (Fig. 6B). Sudadults have a more prominent dorsolateral line, more prominent pale mid lateral spots against darker brown flanks, and a more copper coloured head.



FIGURE 6. Comparison of: (A) *C. wundalthini* **sp. nov.** male (QM J93342), (B) *C. wundalthini* **sp. nov.** female (QM J93347), (C) *C. rubrigularis* male (Mt Lewis), and (D) *C. rubrigularis* female (Mt Lewis).

Comparison with similar species. Distinguished from all other *Carlia*, except *C. rhomboidalis* and *C. rubrigularis*, in having the interparietal fused with the frontoparietal scale. Distinguished from *C. rhomboidalis* and *C. rubrigularis* by male breeding colour. Breeding *C. wundalthini* **sp. nov.** males have an orange flush down the sides of the neck and flanks (Figs 1C, 2, 6A). The chin and throat are uncoloured (except for faint orange sometimes extending onto the sides of the throat from the lower neck, e.g., Fig. 3B). In *C. rhomboidalis* and *C. rubrigularis* breeding colour is restricted to the chin and throat—blue chin and red throat in *C. rhomboidalis* (Fig. 1A), red chin and throat in *C. rubrigularis* (Fig. 1B). The sides of the neck and flanks are brown in both these species, except for red sometimes extending onto the lower sides of the neck in particularly well-coloured males of both species (e.g., Figs 1A, 1B). *Carlia wundalthini* **sp. nov.** is further distinguished from *C. rubrigularis* and *C. rhomboidalis* by ear opening shape and lobules. *Carlia wundalthini* **sp. nov.** has a round to horizontally elongate ear opening, with a sharp triangular anterior lobule and other similar lobules around the top (and sometimes entire) margin of the ear (e.g., Figs 1C, 2, 4A). In contrast, *C. rubrigularis* and *C. rhomboidalis* have a round to (typically) vertically elongate ear opening with one to three large triangular lobules at the front of the ear and typically no or small lobules around the rest of the margin (e.g., Figs 1A, 1B, 4B, 6C, 6D). *Carlia wundalthini* **sp. nov.** is also smaller (SVL mean, range, 43.6 mm, 36.7–49.0) than *C. rubrigularis* (48.7 mm, 44.7–54.6) and *C. rhomboidalis* (48.9 mm, 42.2–54.4), and has a less robust, more gracile build (BW/SVL 0.21, 0.20–0.22; WT/SVL 0.05, 0.04–0.06) than *C. rubrigularis* (BW/SVL 0.24, 0.21–0.27; WT/SVL 0.08, 0.06–0.09) and *C. rhomboidalis* (BW/SVL 0.23, 0.20–0.27; WT/SVL 0.07, 0.06–0.10). Additional more subtle differences include the following. A pale dorsolateral line is rarely evident on adult *C. wundalthini* **sp. nov.**, whereas it is typically evident (and often

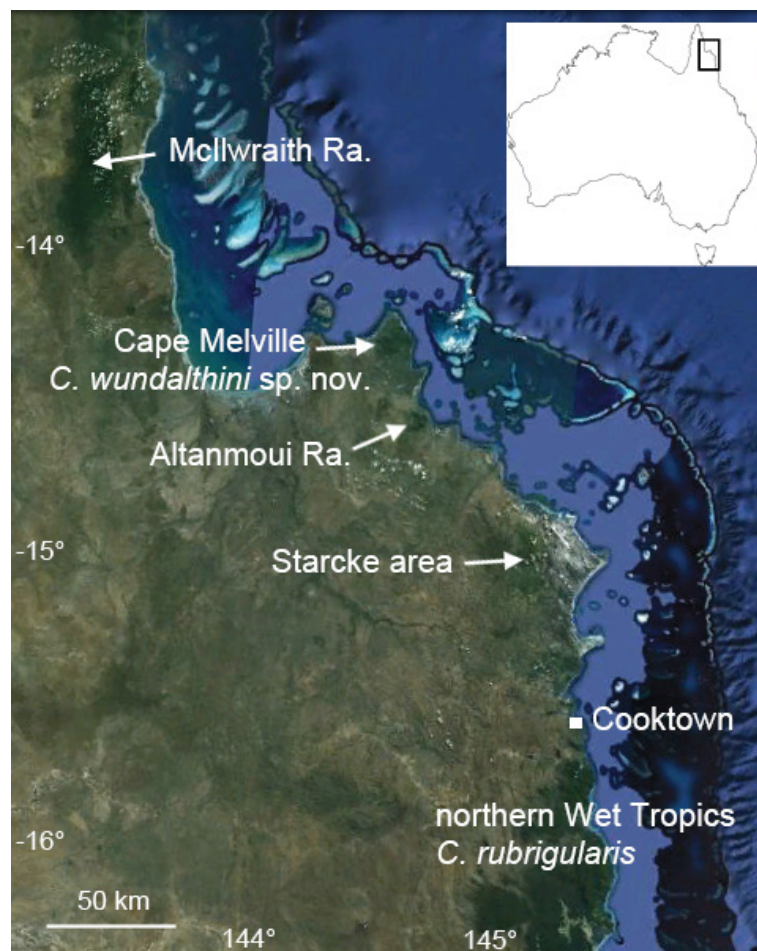


FIGURE 7. Map of north-east Queensland, showing Cape Melville and the northern Wet Tropics region, and the rainforest *Carlia* present in each of these areas. Rainforest areas in McIlwraith Range, Altanmoui Range and the Starcke area are also shown. The inset shows Australia. Background image is from Google Maps (Imagery 2013 NASA, Map data 2013 GBRMPA, Google).

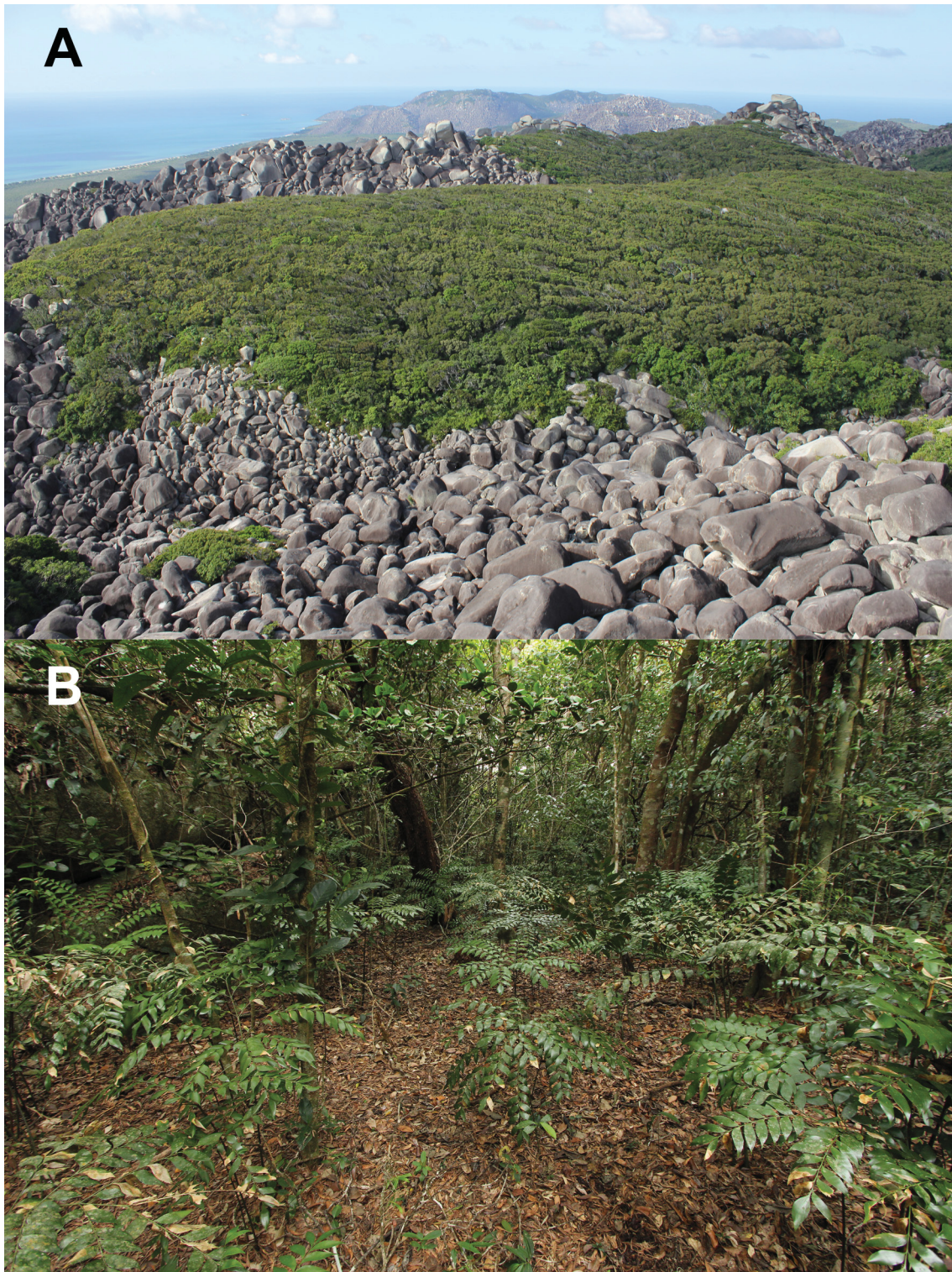


FIGURE 8. Habitat of *C. wundalthini* **sp. nov.**, Melville Range: (A) shows the edge of the rainforest plateau and the extensive boulder-fields that characterize Cape Melville, (B) shows the rainforest at the type locality.

prominent, particularly on females) on *C. rubrigularis* (e.g., Figs 1B, 6D) and *C. rhomboidalis* (e.g., Fig. 1A). White mid-lateral markings are typically reduced to a series of white dots on adult female *C. wundalthini* **sp. nov.** (e.g., Fig. 6B) and are absent on males (e.g., Fig. 2), whereas *C. rubrigularis* and *C. rhomboidalis* females typically have a prominent mid-lateral series of white markings (e.g., Fig. 6D) and males often have some indication of these.

Distribution. Known only from the uplands of the Melville Range, Cape Melville, north-eastern Australia (Fig. 7). Recorded in the vicinity of the type locality (14°16'33" S, 144°29'32" E), at elevations between 450 and 520 m a.s.l., and also in the vicinity of the highest peak (14°16'59" S, 144°29'59" E) at about 600 m a.s.l. *Carlia wundalthini* **sp. nov.** was not recorded during surveys of lowland rainforest at the west and south-east of Melville Range.

Habitat and habits. Found in upland rainforest (Fig. 8). Individuals were found during the day active on the surface of leaf-litter or basking in small sun-patches. When disturbed the skinks hid under the leaf-litter or retreated to tangles of fallen branches or rock crevices. Male *C. wundalthini* **sp. nov.** were in breeding colour in December but not in March. The other skinks found in micro-sympatry were an undescribed species of *Glaphyromorphus* (Hoskin & Couper, in press) and a species of *Lygisaurus* (Hoskin & Hines, under investigation) in the leaf-litter, while *Saproscincus saltus* Hoskin, 2013 was found on rock surfaces in the same habitat. *Carlia longipes* (Macleay, 1877), *Eulamprus brachysoma* (Lönnberg & Andersson, 1915), *Cryptoblepharus fuhni* Covacevich & Ingram, 1978, *Cryptoblepharus virgatus* (Garman, 1901) and *Bellatorias frerei* (Günther, 1897) were found in more open, rockier habitats nearby.

Discussion

The description of *C. wundalthini* **sp. nov.** brings the number of Australian *Carlia* to 24 species (Table 1). The majority of these species occur in open forests and other relatively dry habitats. *Carlia rhomboidalis*, *C. rubrigularis* and *C. wundalthini* **sp. nov.** are exceptions as they primarily occur in rainforests. *Carlia wundalthini* **sp. nov.** is almost certainly restricted to Cape Melville, approximately 170 km north of the closest *C. rubrigularis* records in the northern Wet Tropics and about 600 km north of the nearest populations of *C. rhomboidalis* in the southern Wet Tropics. The rainforest of the Melville Range is highly isolated. The only significant areas of closed forest (rainforest and vine scrubs) between Cape Melville and the Wet Tropics occur in the Altanmoui Range and in the Starcke area (Fig. 7). Brief surveys targeting rainforest reptiles in these areas did not find *C. wundalthini* **sp. nov.** or *C. rubrigularis*, with the more generalist species *C. longipes* occurring in the rainforest at these sites (Hoskin, unpublished data). No species in the *C. rhomboidalis* species-group has been found in the McIlwraith Range, the next significant area of rainforest to the north of Cape Melville (Fig. 7), despite considerable survey effort.

Carlia wundalthini **sp. nov.** has only been recorded in the uplands of the Melville Range and appears to be absent from areas of rainforest and vine scrub around the base. The Melville Range is a low range dominated by extensive granite boulder-fields. Rainforest grows in patches around the base and on the slopes, and on an elevated rainforest plateau of approximately 450 m elevation (highest point 605 m). Despite appearing to be restricted to higher elevations of the Melville Range, *C. wundalthini* **sp. nov.** was common in suitable habitat and is probably not currently threatened. Six endemic vertebrates have already been described from Cape Melville: three frogs, *Litoria andiirmalin* McDonald, 1997, *Cophixalus zweifeli* Davies & McDonald, 1998, *Cophixalus petrophilus* Hoskin, 2013b; two skinks, *Cryptoblepharus fuhni*, *Saproscincus saltus*; and one gecko *Saltuarius eximius* Hoskin & Couper, 2013. *Carlia wundalthini* **sp. nov.** takes this tally to seven, and at least one other endemic vertebrate is known to occur there—a *Glaphyromorphus* skink (Hoskin & Couper, in press).

The majority of these endemic species are allied to rainforest species to the south, and *C. wundalthini* **sp. nov.** is no exception. This level of endemism is exceptional and shows the long-term retention of moist environments in the Melville Range and the ability of these reptiles and frogs to persist in a very small area over a vast period of time. The Melville Range is an unusually rocky environment, in terms of both deeply piled boulder-fields and the amount of boulder habitat in the rainforest. All the endemic reptile species, apart from *C. wundalthini* **sp. nov.**, are closely associated with rock and show adaptations to the rocky environment, for example, in having proportionally long legs (Covacevich & Ingram 1978; Hoskin 2013; Hoskin & Couper 2013, in press). *Carlia wundalthini* **sp. nov.** is the only Cape Melville endemic that was not found in close association with rock, being found instead in rainforest leaf-litter, and it has similar proportional limb lengths (mean L1/SVL = 0.34, mean L2/SVL = 0.46) to *C. rubrigularis* (mean L1/SVL = 0.32, mean L2/SVL = 0.45) in the Wet Tropics to the south. This suggests that sufficient rainforest has persisted through time in the Melville Range for the retention of a rainforest leaf-litter skink

TABLE 1. List of the 24 Australian *Carlia* species. Recent revisions of species are highlighted in the Author column. The species-groups were defined by Zug (2010), with the addition here of *C. decora*, *C. rubigo* and *C. wundalthini* **sp. nov.**. The species-groups generally conform to the phylogeny of Dolman & Hugall (2008), where genetic data is available, with the exception of some inconsistencies in the *tetradactyla* and *triacantha* species-groups.

| Species | Author | Species-group |
|-------------------------------|--|---------------|
| <i>Carlia amax</i> | Storr, 1974 | tetradactyla |
| <i>Carlia decora</i> | Hoskin & Couper, 2012 | vivax |
| <i>Carlia dogare</i> | Covacevich & Ingram, 1975 | vivax |
| <i>Carlia gracilis</i> | Storr, 1974 | gracilis |
| <i>Carlia inconnexa</i> | Ingram & Covacevich, 1989 Elevated by Hoskin & Couper, 2012 | munda |
| <i>Carlia jarnoldae</i> | Covacevich & Ingram, 1975 | gracilis |
| <i>Carlia johnstonei</i> | Storr, 1974 | triacantha |
| <i>Carlia longipes</i> | (Macleay, 1877) Revised by Donnellan <i>et al.</i> , 2009 | fusca |
| <i>Carlia munda</i> | (de Vis, 1885) | munda |
| <i>Carlia pectoralis</i> | (de Vis, 1884) Revised by Hoskin & Couper, 2012 | munda |
| <i>Carlia quinquecarinata</i> | (Macleay, 1877) Revised by Donnellan <i>et al.</i> , 2009 | fusca |
| <i>Carlia rhomboidalis</i> | (Peters, 1869) | rhomboidalis |
| <i>Carlia rimula</i> | Ingram & Covacevich, 1980 | not assigned |
| <i>Carlia rostralis</i> | (de Vis, 1885) | vivax |
| <i>Carlia rubigo</i> | Hoskin & Couper, 2012 | munda |
| <i>Carlia rubrigularis</i> | Ingram & Covacevich, 1989 | rhomboidalis |
| <i>Carlia rufilatus</i> | Storr, 1974 | triacantha |
| <i>Carlia schmeltzii</i> | (Peters, 1867) | bicarinata |
| <i>Carlia sexdentata</i> | (Macleay, 1877) Revised by Donnellan <i>et al.</i> , 2009 | fusca |
| <i>Carlia storri</i> | Ingram & Covacevich, 1989 | bicarinata |
| <i>Carlia tetradactyla</i> | (O'Shaughnessy, 1879) | tetradactyla |
| <i>Carlia triacantha</i> | (Mitchell, 1953) | triacantha |
| <i>Carlia vivax</i> | (de Vis, 1884) | vivax |
| <i>Carlia wundalthini</i> | This paper | rhomboidalis |

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APPENDIX. Additional material examined.

***Carlia rubrigularis*:** QM J17889, Palmerston SF, 16 km W of Innisfail (17°34' S, 145°53' E); QM J17901, Shiptons Flat, 32–48 km S of Cooktown (15°48' S, 145°16' E); QM J22667, Big Tableland, approx. 32 km SE of Cooktown (15°43' S, 145°17' E); QM J24649, Shiptons Flat, via Cooktown (15°48' S, 145°16' E); QM J25146, Home Rule, Mt Hedley Spur (15°44' S, 145°17' E); QM J25190, Home Rule, S of Cooktown (15°44' S, 145°17' E); QM J25198–25200, on Granite Ck to Cedar Bay track (15°45' S, 145°20' E); QM J25209, Horan Ck, Mt Finnigan NP (15°49'10" S, 145°16'50" E); QM J25212, Home Rule Falls (15°44' S, 145°17' E); QM J25240, QM J25245, Mt Hedley slopes (15°44' S, 145°16' E); QM J25249, Mt Hartley, near Home Rule, S of Cooktown (15°46' S, 145°19' E); QM J25293, near Home Rule Falls (15°44' S, 145°18' E); QM J25296, Gap Ck, 12 Mile Scrub (15°48'30" S, 145°19'30" E); QM J27004, QM J27006, Crowley Ck, via Mt Molloy (16°42' S, 145°24' E); QM J27080, Spear Ck, via Mt Molloy (16°42' S, 145°24' E); QM J27129, QM J27139, QM J27140, Shiptons Flat (15°48' S, 145°16' E); QM J27266, Mt Finlay (15°49' S, 145°21' E); QM J29956, 24 km N of Cairns (16°45' S, 145°39' E). ***Carlia rhomboidalis*:** QM J53405, Mt Charlton foothills, via Mount Charlton (21°01' S, 148°44' E); QM J53496, E Funnel Ck, 12–15 km SW of Sarina (21°36' S, 149°12' E); QM J53576, Coffee Ck, Mt Jukes, via Mackay (20°59' S, 148°57' E); QM J67608, Charappa Ck (17°42'30" S, 145°40'30" E); QM J74124, QM J74761, QM J74762, Crediton Track, Wishing Pool, Eungella NP (21°10'30" S, 148°31'30" E); QM J75682, Finch Hatton Gorge (21°04'30" S, 148°38'30" E); QM J77664, Conway State Forest (20°21'00" S, 148°45'20" E); QM J79277, Mt Elliot NP (19°26'30" S, 146°56'40" E); QM J80868, Crediton State Forest (21°16'19" S, 148°32'26" E); QM J82696, QM J82698, QM J82702, QM J82704, QM J82706, QM J82721, Diamond Cliffs (21°22'50" S, 148°34'25" E); QM J89120, Cid Harbour, Whitsunday Island (20°15'36" S, 148°57'26" E); QM J89121, QM J89122, Cid Harbour, Whitsunday Island (20°15'46" S, 148°57'48" E); QM J89143, Airlie Beach, Shute Harbour Rd, Mandalay (20°17' S, 148°44' 21" E).